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Customer No. 23,696

PENDING CLAIMS

This listing of claims will replace all prior versions and listings of claims in the

application.

1.　(Previously Presented) A method of estimating a communication

channel impulse response h (t) , comprising the steps of:

generating co_m (t) = co (t + mNT_c) for m = 0,1, ... , M by correlating a received

signal r(t) with a spreading sequence S_i of length N, wherein the received signal r(t)

comprises a chip sequence c_j applied to a communication channel characterizable by the

communication channel impulse response h(t), and wherein the chip sequence c_j is

generated from a data sequence d_i spread by the spreading sequence S_i and wherein T_c is

the chip period of the chip sequence c_j;

generating an estimated communication channel impulse response $\hat{h}_M$ (t) as

a combination of co_m(t) and d_m for m = 0 ,1, ... , M, where d_m is the m-th symbol

and M is number of symbols used to generate the estimated communication channel

impulse response $\hat{h}_M$ (t); and

filtering the estimated communication channel impulse response $\hat{h}_M$ (t) with a filter

f to generate a filtered estimate of the communication channel impulse response h(t),

the filter f being selected at least in part according to the spreading sequence S_i.

2.　(Original) The method of claim 1, wherein the filter f is further selected

at least in part according to an autocorrelation A(n) of the spreading sequence S_i.

3.　(Previously Presented) The method of claim 2, wherein the filter f is

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further selected at least in part according to the duration of the communication channel

impulse response h(t).

4. (Previously Presented) The method of claim 2, wherein the filter f is

further selected at least in part according to a zero-forcing criteria

$$\sum_{i=-L}^{L}(A(n-i) \bullet f(i)) = A_f(n), -L \leq n \leq L, \text{ wherein:}$$

f(i) is an impulse response of the filter f such that $A_f(n)$ is a convolution of

A(n) and f(i);

$A_f(n) = 1$ for $n = 0$ and $A_f(n) = 0$ for $0 < |n| \leq L$; and

$$A(n) = A(-n) = \sum_{i=0}^{N-1-n} S_i \bullet S_{i+n}, 0 \leq n \leq N.$$

5. (Original) The method of claim 4, wherein:

the parameter L is chosen such that a time duration of the impulse response

of the communication channel h (t) is less than LT_c.

6. (Original) The method of claim 4, wherein:

the parameter L is chosen such that a time duration of the impulse response

of the communication channel h (t) is approximately equal to LT_c.

7. (Original) The method of claim 1, wherein N is less than 20.

8. (Previously Presented) The method of claim 1, wherein M = 1.

9. (Previously Presented) The method of claim 1, wherein the data sequence d_i

includes a constrained portion Cd_i associated with at least two codes w_0, w_1, wherein a

correlation $A_{code}(k)$ of the constrained portion Cd_i with one of the codes w_0, w_1 is

characterized by a maximum value at k = 0 and less than maximum values at $k \neq 0$.

10.   (Previously Presented) The method of claim 1, wherein the step of generating

an estimated communication channel impulse response $\hat{h}_M(t)$ as a combination of $co_m(t)$

and d_m for $m = 0, 1, ..., M$ comprises the step of computing $\hat{h}_M(t)$ as

$$(1/M)\sum_{m=0}^{M-1} d_m \bullet co(t+mNT_c).$$

11.   (Original) The method of claim 10, wherein M=2.

12.   (Original) The method of claim 9, wherein the data sequence d_i includes a

preamble having a pseudorandom code including the constrained portion of the data

sequence d_i.

13.   (Original) The method of claim 9, wherein $A_{code}(k) =1$ at $k = 0$ and

$A_{code}(k) = 0$ for substantially all $k \neq 0$.

14.   (Original) The method of claim 9, wherein $A_{code}(k)=0$ for $0 < |k| \leq J$,

wherein J is selected to minimize the correlation of the constrained portion Cd_i with the

one of the codes w_0, w_1 for substantially all $k \neq 0$.

15.   (Original) The method of claim 14, wherein 2J is a length of the

constrained Cd_i.

16.   (Previously Presented) The method of claim 9, wherein $A_{code}(k) =1$ at

$k=0$ and $A_{code}(k) \approx 0$ for substantially all $k \neq 0$.

17.   (Previously Presented) The method of claim 9, wherein each of the at

least two codes w_0, w_1 comprises two symbols.

18.   (Previously Presented) The method of claim 9, wherein each of the at

least two codes w_0, w_1 comprises no more than two symbols.

19.   (Previously Presented) The method of claim 9, wherein the codes w_0, w_1

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comprise Walsh codes.

20. (Previously Presented) An apparatus for estimating a communication channel impulse response h(t), comprising:

means for generating $co_m(t) = co(t + mNT_c)$ for $m = 0, 1, \ldots, M$ by correlating a received signal r(t) with a spreading sequence S_i of length N, wherein the received signal r(t) comprises a chip sequence c_j applied to a communication channel characterizable by the communication channel impulse response h(t), and wherein the chip sequence c_j is generated from a data sequence d_i spread by the spreading sequence S_i, and wherein T_c is the chip period of the chip sequence c_j;

means for generating an estimated communication channel impulse response $\hat{h}_M(t)$ as a combination of $co_m(t)$ and d_m for $m = 0, 1, \ldots, M$, where d_m is the m-th symbol and M is number of symbols used to generate the estimated communication channel impulse response $\hat{h}_M(t)$; and

a filter means f, selected at least in part according to the spreading sequence S_i, the filter means for filtering the estimated communication channel impulse response $\hat{h}_M(t)$ to generate a filtered estimate of the communication channel impulse response h(t).

21. (Original) The apparatus of claim 20, wherein the filter means f is further selected at least in part according to an autocorrelation A(n) of the spreading sequence S_i.

22. (Previously Presented) The apparatus of claim 21, wherein the filter means f is further selected at least in part according to the duration of the communication channel impulse response h(t).

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23.   (Previously Presented) The apparatus of claim 21, wherein the filter means f

is further selected at least in part according to a zero-forcing criteria

$$\sum_{i=-L}^{L}(A\,(n\text{-}i) \cdot f(i)) = A_f\,(n),\ -L \leq n \leq L,\ \text{wherein:}$$

f(i) is an impulse response of the filter means f such that $A_f(n)$ is a

convolution of A(n) and f(i);

$A_f(n) = 1$ for $n = 0$ and $A_f(n) = 0$ for $0 < |n| \leq L$; and

$$A(n) = A(-n) = \sum_{i=0}^{N-1-n} S_i \cdot S_{i+n},\ 0 \leq n \leq N.$$

24.   (Original) The apparatus of claim 23, wherein:

the parameter L is chosen such that a time duration of the impulse response of the

communication channel h(t) is less than LT_c.

25.   (Original) The apparatus of claim 23, wherein:

the parameter L is chosen such that a time duration of the impulse response of the

communication channel h(t) is approximately equal to LT_c.

26.   (Original) The apparatus of claim 20, wherein N is less than 20.

27.   (Previously Presented) The apparatus of claim 20, wherein

M=1.

28.   (Previously Presented) The apparatus of claim 20, wherein the data

sequence d_i includes a constrained portion Cd_i associated with at least two codes w_0, w_1,

wherein a correlation $A_{code}(k)$ of the constrained portion Cd_i with one of the codes w_0,

w_1 is characterized by a maximum value at $k = 0$ and less than maximum values at

$k \neq 0$.

29.   (Previously Presented) The apparatus of claim 20, wherein the means for

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generating an estimated communication channel impulse response $\hat{h}_M(t)$ as a

combination of $co_m(t)$ and d_m for m = 0,1, ... , M comprises means for computing $\hat{h}_M(t)$

as

$$(1/M)\sum_{m=0}^{M-1} d_m \bullet co(t+mNT_c)$$

30.   (Original) The apparatus of claim 29, wherein M = 2.

31.   (Original) The apparatus of claim 28, wherein the data sequence d_i

includes a preamble having a pseudorandom code including the constrained portion of

the data sequence d_i.

32.   (Original) The apparatus of claim 28, wherein $A_{code}(k)=1$ at k = 0

and $A_{code}(k) = 0$ for substantially all $k \neq 0$.

33.   (Original) The apparatus of claim 28, wherein $A_{code}(k)=0$ for $0<|k|\leq J$

wherein J is selected to minimize the correlation of the constrained portion Cd_i with

the one of the codes w_0, w_1 for substantially all $k \neq 0$.

34.   (Original) The apparatus of claim 33, wherein 2J is a length of the

constrained portion Cd_i.

35.   (Previously Presented) The apparatus of claim 28, wherein

$A_{code}(k)=1$ at k = 0 and $A_{code}(k) \approx 0$ for substantially all $k \neq 0$.

36.   (Previously Presented) The apparatus of claim 28, wherein each of the at

least two codes w_0, w_1 comprises two symbols.

37.   (Previously Presented) The apparatus of claim 28, wherein each of the at

least two codes w_0, w_1 comprises no more than two symbols.

38.   (Previously Presented) The apparatus of claim 28, wherein the codes w_0,

w_1 comprise Walsh codes.

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39. (Previously Presented) An apparatus for estimating a communication

channel impulse response h(t), comprising:

a correlator generating $co_m(t) = co(t + mNT_c)$ for m = 0,1, ... , M by correlating

a received signal r(t) with a spreading sequence S_i of length N, wherein the received

signal r(t) comprises a chip sequence c_j applied to a communication channel

characterizable by the communication channel impulse response h(t), and wherein the

chip-sequence-c_j-is-generated-from-a-data-sequence-d_i-spread-by-the-spreading

sequence S_i, and wherein T_c is the chip period of the chip sequence c_j;

an estimator for generating an estimated communication channel impulse

response $\hat{h}_M(t)$ as a combination of $co_m(t)$ and d_m for m = 0,1, ... , M where d_m is the

m-th symbol and M is number of symbols used to generate the estimated

communication channel impulse response $\hat{h}_M(t)$; and

a filter f selected at least in part according to the spreading sequence S_i, the

filter for filtering the estimated communication channel impulse response $\hat{h}_M(t)$ to

generate a filtered estimate of the communication channel impulse response h(t).

40. (Original) The apparatus of claim 39, wherein the filter f is further

selected at least in part according to an autocorrelation A(n) of the spreading

sequence S_i.

41. (Previously Presented) The apparatus of claim 40, wherein the filter f is

further selected at least in part according to the duration of the communication channel

impulse response h(t).

42. (Previously Presented) The apparatus of claim 40, wherein the filter f is

further selected at least in part according to a zero-forcing criteria

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$$\sum_{i=-L}^{L}(A\,(n-i) \cdot f(i)) = A_f\,(n), \; -L \leq n \leq L, \text{ wherein:}$$

f(i) is an impulse response of the filter f such that $A_f\,(n)$ is a convolution of

A(n) and f(i);

$A_f\,(n) = 1$ for n = 0 and $A_f\,(n) = 0$ for $0 < |n| \leq L$; and

$$A(n) = A(-n) = \sum_{i=0}^{N-1-n} S_i \cdot S_{i+n}, \; 0 \leq n \leq N.$$

43.   (Original) The apparatus of claim 42, wherein:

the parameter L is chosen such that a time duration of the impulse response of

the communication channel h(t) is less than LT_c.

44.   (Original) The apparatus of claim 42, wherein:

the parameter L is chosen such that a time duration of the impulse response of the

communication channel h(t) is approximately equal to LT_c.

45.   (Original) The apparatus of claim 39, wherein N is less than

20.

46.   (Previously Presented) The apparatus of claim 39, wherein M

=1.

47.   (Previously Presented) The apparatus of claim 39, wherein the data

sequence d_i includes a constrained portion Cd_i associated with at least two codes

w_0, w_1, wherein a correlation $A_{code}(k)$ of the constrained portion Cd_i with one of the

codes w_0, w_1 is characterized by a maximum value at k = 0 and less than maximum

values at $k \neq 0$.

48.   (Previously Presented) The apparatus of claim 39, wherein the estimator

for generating an estimated communication channel impulse response $\hat{h}_M$ (t) as a

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combination of $co_m(t)$ and d_m for $m = 0,1, \ldots, M$ comprises means for computing $\hat{h}_M(t)$ as

$$(1/M)\sum_{m=0}^{M-1} d_m \bullet co(t+mNT_c).$$

49.   (Original) The apparatus of claim 48, wherein $M = 2$.

50.   (Original) The apparatus of claim 47, wherein the data sequence d_i includes a preamble having a pseudorandom code including the constrained portion of the data sequence d_i.

51.   (Original) The apparatus of claim 47, wherein $A_{code}(k)=1$ at $k=0$ and $A_{code}(k)=0$ for substantially all $k\neq 0$.

52.   (Original) The apparatus of claim 47, wherein $A_{code}(k)=0$ for $0<|k|\leq J$, wherein J is selected to minimize the correlation of the constrained portion Cd_i with the one of the codes w_0, w_1 for substantially all $k\neq 0$.

53.   (Original) The apparatus of claim 52, wherein 2J is a length of the constrained portion Cd_i.

54.   (Previously Presented) The apparatus of claim 47, wherein $A_{code}(k)=1$ at $k=0$ and $A_{code}(k)\approx 0$ for substantially all $k\neq 0$.

55.   (Previously Presented) The apparatus of claim 47, wherein each of the at least two codes w_0, w_1 comprises two symbols.

56.   (Previously Presented) The apparatus of claim 47, wherein each of the at least two codes w_0, w_1 comprises no more than two symbols.

57.   (Previously Presented) The apparatus of claim 47, wherein the codes w_0, w_1 comprise Walsh codes.

58.   (Previously Presented) A method of estimating a communication channel

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response, comprising:

obtaining a received sequence via a communication channel, the received sequence comprising a chip sequence generated by spreading a data sequence with a spreading sequence;

generating a correlated sequence by correlating the received sequence with the spreading sequence;

generating an estimated communication channel impulse response based on the correlated sequence and a known portion of the data sequence; and

filtering the estimated communication channel impulse response based on a filter to obtain a filtered estimate of the communication channel impulse response, the filter being selected based on the spreading sequence.

59. (Previously Presented) The method of claim 58, wherein the generating the estimated communication channel impulse response comprises

multiplying multiple data symbols in the known portion with the correlated sequence at multiple time offsets, and

generating the estimated communication channel impulse based on a sum of results of the multiplication.

60. (Previously Presented) The method of claim 58, wherein the filter is selected such that convolution of an impulse response of the filter and an autocorrelation of the spreading sequence is non-zero at center of the autocorrelation and is zero for a predetermined range to the left and right of the center of the autocorrelation.

61. (Previously Presented) The method of claim 58, wherein the spreading sequence is an 11-chip Barker sequence.

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62. (Previously Presented) The method of claim 58, wherein the known portion of the data sequence is selected such that correlation of the known portion with a code is characterized by a maximum value at one point in the known portion and less than maximum values at all other points in the known portion, and wherein the estimated communication channel impulse response is generated further based on the code.

63. (Previously Presented) An apparatus for estimating a communication channel impulse response, comprising:

~~means for obtaining a received sequence via a communication channel, the~~ received sequence comprising a chip sequence generated by spreading a data sequence with a spreading sequence;

means for generating a correlated sequence by correlating the received sequence with the spreading sequence;

means for generating an estimated communication channel impulse response based on the correlated sequence and a known portion of the data sequence; and

means for filtering the estimated communication channel impulse response based on a filter to obtain a filtered estimate of the communication channel impulse response, the filter being selected based on the spreading sequence.

64. (Previously Presented) The apparatus of claim 63, wherein the means for generating the estimated communication channel impulse response comprises

means for multiplying multiple data symbols in the known portion with the correlated sequence at multiple time offsets, and

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means for generating the estimated communication channel impulse based on a

sum of results of the multiplication.

65.   (Previously Presented) The apparatus of claim 63, wherein the filter is

selected such that convolution of an impulse response of the filter and an autocorrelation

of the spreading sequence is non-zero at center of the autocorrelation and is zero for a

predetermined range to the left and right of the center of the autocorrelation.

66.   (Previously Presented) The apparatus of claim 63, wherein the spreading

sequence is an 11-chip Barker sequence.

~~67.   (Previously Presented) The apparatus of claim 63, wherein the known~~

portion of the data sequence is selected such that correlation of the known portion

with a code is characterized by a maximum value at one point in the known portion

and less than maximum values at all other points in the known portion, and wherein

the estimated communication channel impulse response is generated further based

on the code.

68.   (Currently Amended) An apparatus for estimating a communication

channel impulse response, ~~comprising a processor configured~~ the apparatus

comprising

a processor;

a memory coupled to the processor, wherein the memory stores software codes

that include instructions to be implemented by the processor to:

[[to]] a) obtain a received sequence via a communication channel, the

received sequence comprising a chip sequence generated by spreading a data

sequence with a spreading sequence;

[[to]] b) generate a correlated sequence by correlating the received sequence with the spreading sequence;

[[to]] c) generate an estimated communication channel impulse response based on the correlated sequence and a known portion of the data sequence; and

[[to]] d) filter the estimated communication channel impulse response based on a filter to obtain a filtered estimate of the communication channel impulse response, the filter being selected based on the spreading sequence.

69.   (Currently Amended) The apparatus of claim 68, wherein ~~to generate the estimated communication channel impulse response, the processor is configured the~~ software codes further include instructions to be implemented by the processor to

[[to]] multiply multiple data symbols in the known portion with the correlated sequence at multiple time offsets, and

[[to]] generate the estimated communication channel impulse based on a sum of results of the multiplication when the processor is configured to generate the estimated communication channel impulse response.

70.   (Previously Presented) The apparatus of claim 68, wherein the filter is selected such that convolution of an impulse response of the filter and an autocorrelation of the spreading sequence is non-zero at center of the autocorrelation and is zero for a predetermined range to the left and right of the center of the autocorrelation.

71.   (Previously Presented) The apparatus of claim 68, wherein the spreading sequence is an 11-chip Barker sequence.

72.   (Previously Presented) The apparatus of claim 68, wherein the known portion of the data sequence is selected such that correlation of the known portion with a code is characterized by a maximum value at one point in the

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known portion and less than maximum values at all other points in the known

portion, and wherein the estimated communication channel impulse response is

generated further based on the code.

73.　(Currently Amended) A computer-readable medium ~~having~~

~~computer-executable code, the code comprising instructions for estimating a~~

~~communication channel response, the instructions comprising the steps of~~ including

program code stored thereon, comprising:

program codes for obtaining a received sequence via a communication

~~channel, the received sequence comprising a chip sequence generated by spreading a~~

data sequence with a spreading sequence;

program codes for generating a correlated sequence by correlating the

received sequence with the spreading sequence;

program codes for generating an estimated communication channel impulse

response based on the correlated sequence and a known portion of the data sequence;

and

program codes for filtering the estimated communication channel impulse

response with a filter to obtain a filtered estimate of the communication channel

impulse response, the filter being selected based on the spreading sequence.

74.　(Currently Amended) The computer-readable medium of claim 73,

~~wherein the step of generating the estimated communication channel impulse~~

~~response~~ further ~~comprises~~ comprising:

program codes for multiplying multiple data symbols in the known portion

with the correlated sequence at multiple time offsets, and

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program codes for generating the estimated communication channel

impulse based on a sum of results of the multiplication.

75.   (Currently Amended) The computer-readable medium of claim 73,

wherein the filter is selected such that convolution of an impulse response of the filter

and an autocorrelation of the spreading sequence is non-zero at center of the

autocorrelation and is zero for a predetermined range to the left and right of the

center of the autocorrelation.

76.   (Previously Presented) The computer-readable medium of claim 73,

wherein the spreading sequence is an 11-chip Barker sequence.

77.   (Currently Amended) The computer-readable medium of claim 73,

wherein the known portion of the data sequence is selected such that correlation of

the known portion with a code is characterized by a maximum value at one point in

the known portion and less than maximum values at all other points in the known

portion, and wherein the estimated communication channel impulse response is

generated further based on the code.

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